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ABSTRACT

Time-shared, Interactive, Computer-Controlled Information Television (TICCIT) is a computer-based system of instruction designed to provide low-cost, high-quality education that is completely individualized. Using inexpensive minicomputers, color television sets, and typewriter-like keyboards, TICCIT can serve as many as 128 students simultaneously. The system is designed to substitute for classroom instruction. It permits efficient use of instructional space, frees instructors from routine teaching tasks, and provides more flexible scheduling for individual students. TICCIT courses in English composition and mathematics have been installed in community colleges in Virginia and Arizona, and TICCIT courses form part of the curriculum of Brigham Young University. TICCIT systems are being used for training at several military installations. The newest application of TICCIT is in the area of special education. TICCIT programs serve severely handicapped, homebound children in Amherst, New York, and deaf students at the Model Secondary School for the Deaf in Washington, D.C. (Author/PF)

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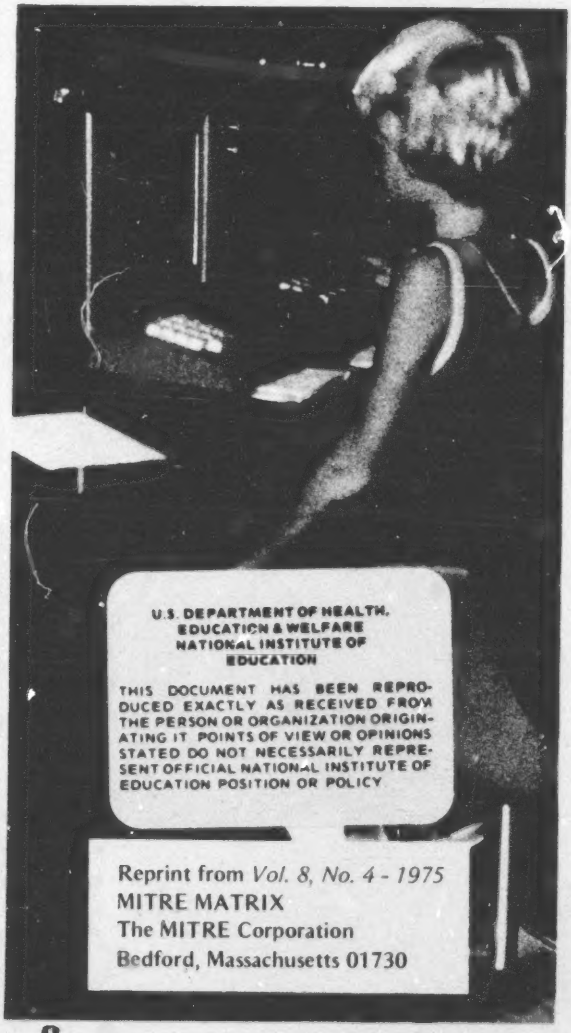
Tailor-Made Teaching Through

TICCIT

by Wanda Rappaport and Elizabeth Olenbush



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MITRE MATRIX
The MITRE Corporation
Bedford, Massachusetts 01730

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Time-shared, Interactive, Computer-Controlled Information Television, better known as TICCIT, is a new, computer-based system of instruction designed by MITRE to provide low-cost, high-quality education that is completely individualized. Originally invented in the course of a MITRE Independent Research and Development project, TICCIT was further developed under National Science Foundation funding. It uses state-of-the-art hardware, combined with course materials (courseware) that reflect the latest thinking in the field of instructional psychology.

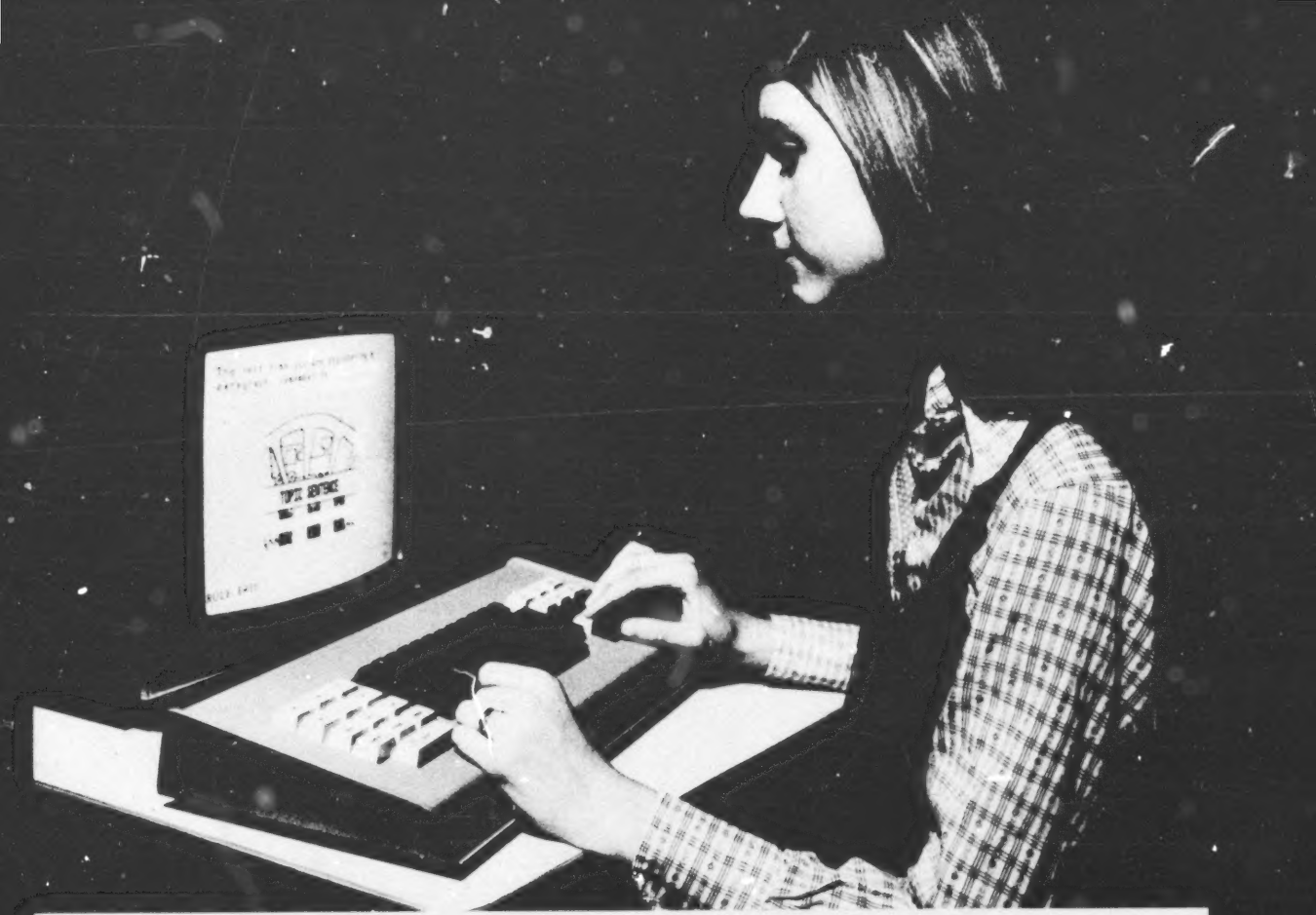
William F. Mason, Technical Director of the Systems Development Division at MITRE's Washington Operations, believes the system will prove to be the first financially viable computer-aided instruction (CAI) system, and that it is the forerunner of a new generation of services that will be delivered to home television sets in the future.

TICCIT systems are now being used at a university, two community colleges, several military installations, within a community to serve handicapped children at home, and at MITRE's Washington Operations. Several additional applications are also being planned. The MITRE TICCIT work is being carried out in the Computer Systems Department, headed by John L. Volk.

Using inexpensive minicomputers, color television sets, and typewriter-like keyboards, TICCIT is designed to serve as many as 128 students simultaneously. The student terminal is one of the features which sets TICCIT apart from other CAI systems and enables the student to see, hear, and respond to instructional materials. The materials take the form of rules, examples, and practice exercises, which are displayed to the student on a color television set. These displays include computer-generated alphanumerics and graphics in seven colors as well as supplementary videotapes and audio.

Using TICCIT's specially designed, learner-controlled keyboard, the individual student determines his own style of instruction. A rule, example, or practice item is displayed on the TV screen only when the student depresses the appropriate key. Even the complexity level of these displays is controlled by the student; "easy" and "hard" keys change the level of complexity for each individual item. And if the student has difficulty understanding any rule, example, or practice item, there is a "help" key which calls up a step-by-step explanation of the troublesome item.

With so many choices available, a student sometimes needs advice about what to do next or what options are available. This assistance is provided when the student presses the "advice" key. The system keeps track of what the student does, so that when he asks for advice, his past performance together with specifications by the author of the courseware serve as the



MITRE's Deborah Holloway tries out the TICCIT system at Northern Virginia Community College.

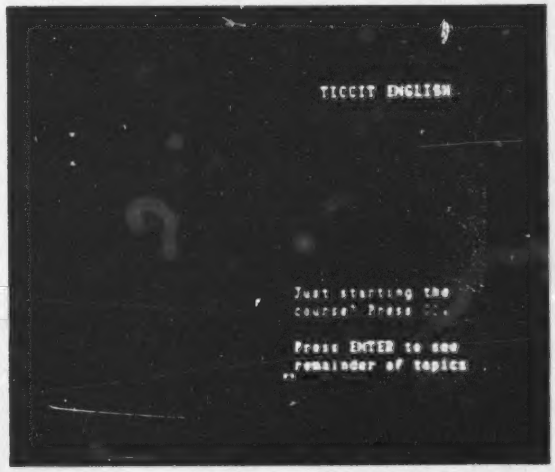
basis for appropriate computer-generated advice. If a student cannot resolve a problem using the various system options and computer advice, a proctor and/or instructor is available to give guidance.

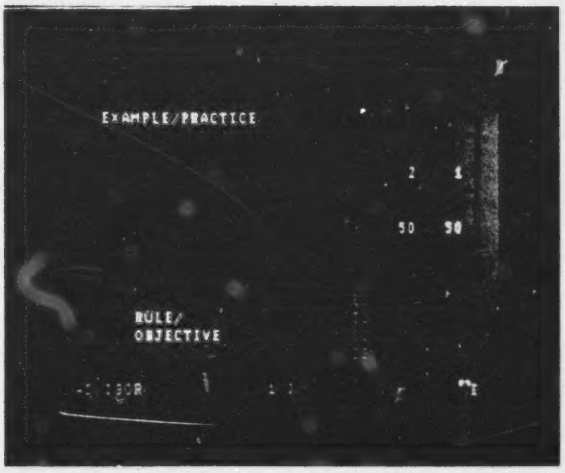
ADVANTAGES OF TICCIT

TICCIT's ability to provide students with completely individualized, learner-controlled instruction is one of its primary advantages over more traditional instruction. This individualization is predicated upon student decision-making, with each student proceeding at his own pace through a personally tailored course. The modular structure of the courseware, the rule-example-practice format within each segment of instruction, and several levels of complexity for all instructional material permit the student to develop a distinctive structure appropriate to his personal learning style.

The capabilities of the computer system itself enhance TICCIT's instructional effectiveness. Rapid feedback (an average response time of less than 0.5 second) permits students to assess their progress immediately and to seek help or go on to more difficult material without delay. The system serves each student independently, and varied modes of presentation, including graphics, color, videotapes, and audio, not only add variety to the instruction but also emphasize interrelationships between concepts and examples.

In addition to instructional advantages for students, the TICCIT system offers a number of potential advantages to educational institutions and the community at large. Education is a labor-intensive industry with salaries and associated personnel costs

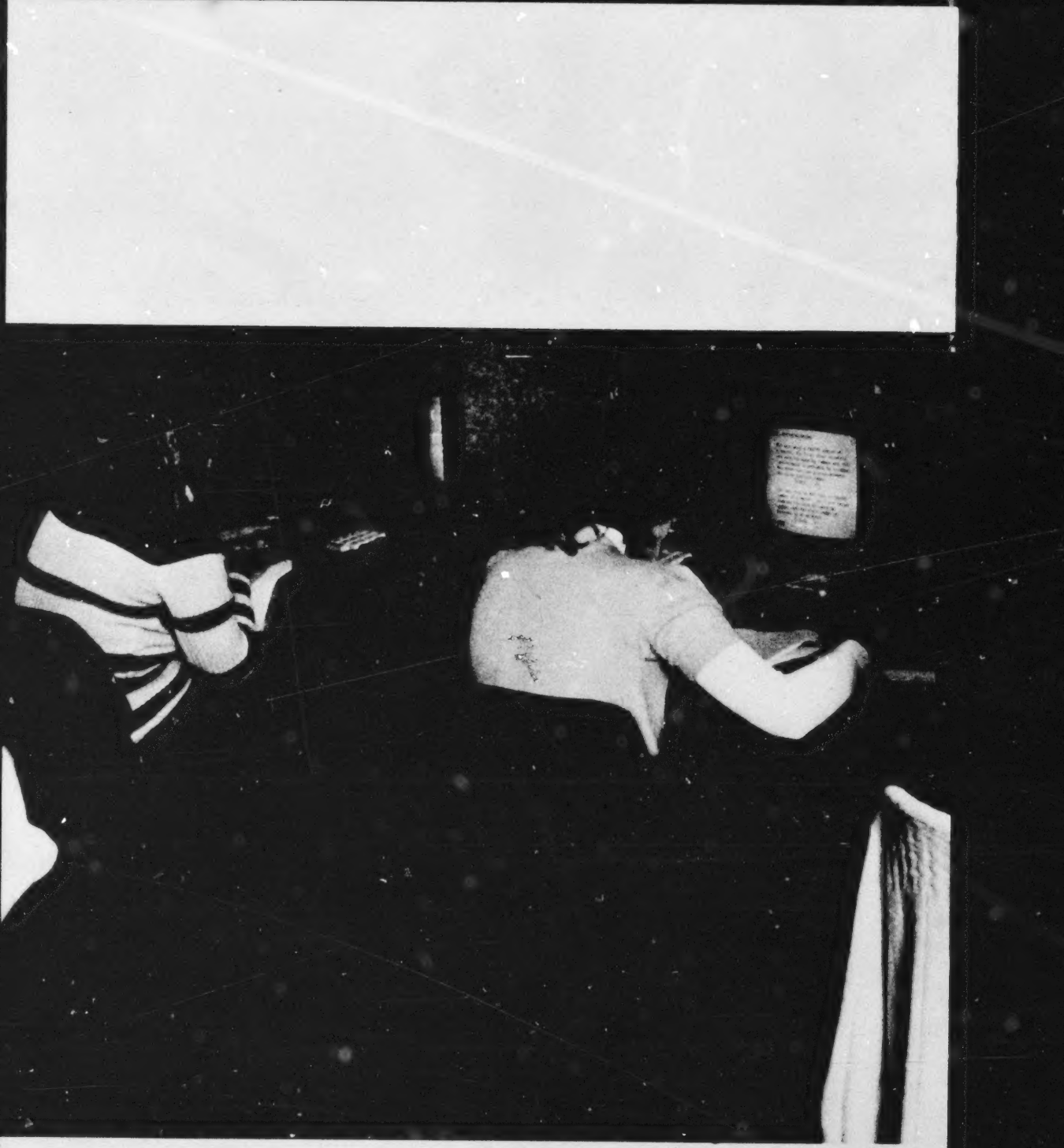




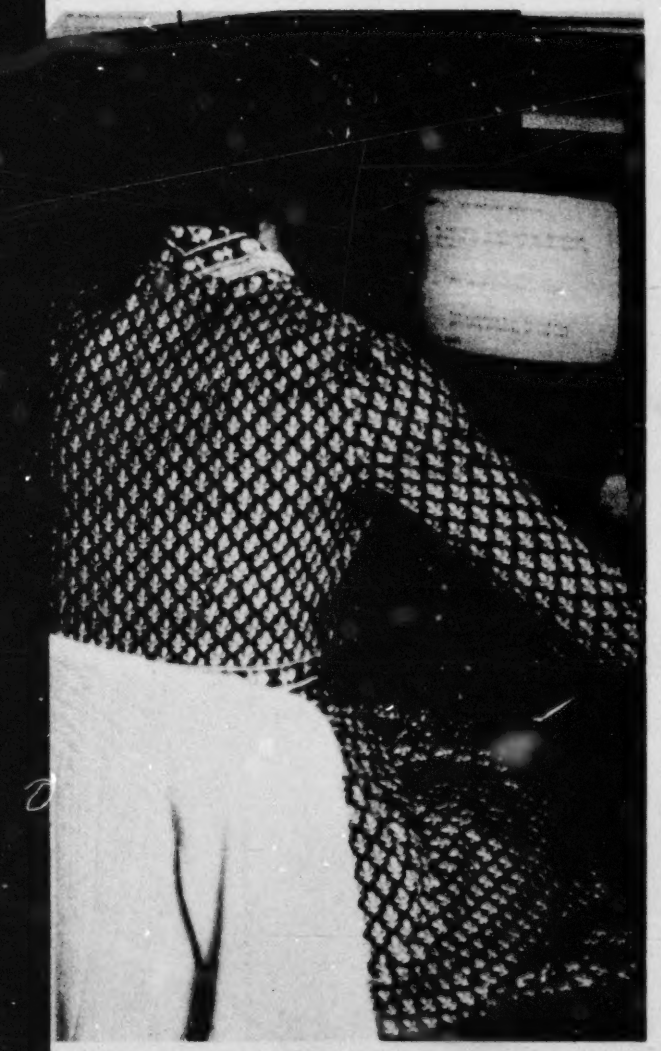
Individualized instruction is fostered by the modular structure of TICCIT's courseware, its rule-example-practice format, several levels of complexity for all material, computer-generated advice, and varied modes of presentation — as shown by these typical TICCIT displays.

constituting a major portion of expenditures. TICCIT represents one approach which can be taken to ameliorate the effects of rising instructional costs without sacrificing quality. Since the system is designed to substitute for classroom instruction, rather than only supplement it as most CAI systems do, TICCIT does not represent an added cost for an institution. Furthermore, while labor costs are rising, computer hardware costs are falling.

TICCIT also makes possible more efficient allocation of an instructor's time, freeing faculty members and other instructors from many routine teaching tasks. At the same time, it can increase interaction between students and teachers. Because the computer system and para-professional



TICCIT permits efficient use of instructional space, also freeing instructors from many routine teaching tasks and providing more flexible scheduling for individual students.



proctors handle many routine instructional tasks, teachers are available for more individual tutoring and problem-solving.

Additional savings can accrue to institutions through TICCIT's more efficient use of instructional space. By permitting students taking different courses to use the same room simultaneously, TICCIT enables more students to be served per unit of time.

TICCIT not only increases flexibility in scheduling instructional space, it also provides scheduling flexibility for individual students. Students can spend as few or as many hours as desired on a course. The only limitation is terminal availability - and the system will support 128 users simultaneously. Furthermore, once students complete a TICCIT course, they can register immediately for the next one. And students not registered in TICCIT courses can take advantage of selected TICCIT modules for either review or remedial work.

COLLEGE APPLICATIONS

TICCIT was conceived as a long-range program for development, demonstration, and evaluation of CAI at the community college level. The TICCIT design team consisted of MITRE, the prime contractor, responsible for hardware and software systems; the Institute for Computer Uses in Education at Brigham Young University in Provo, Utah, responsible for courseware development; and two participating community colleges, responsible

for implementing and administering demonstration of the system. The Educational Testing Service of Princeton, New Jersey, under separate contract from the National Science Foundation, is conducting an independent evaluation of the educational and technical effectiveness of TICCIT as well as the cost of developing and implementing the program.

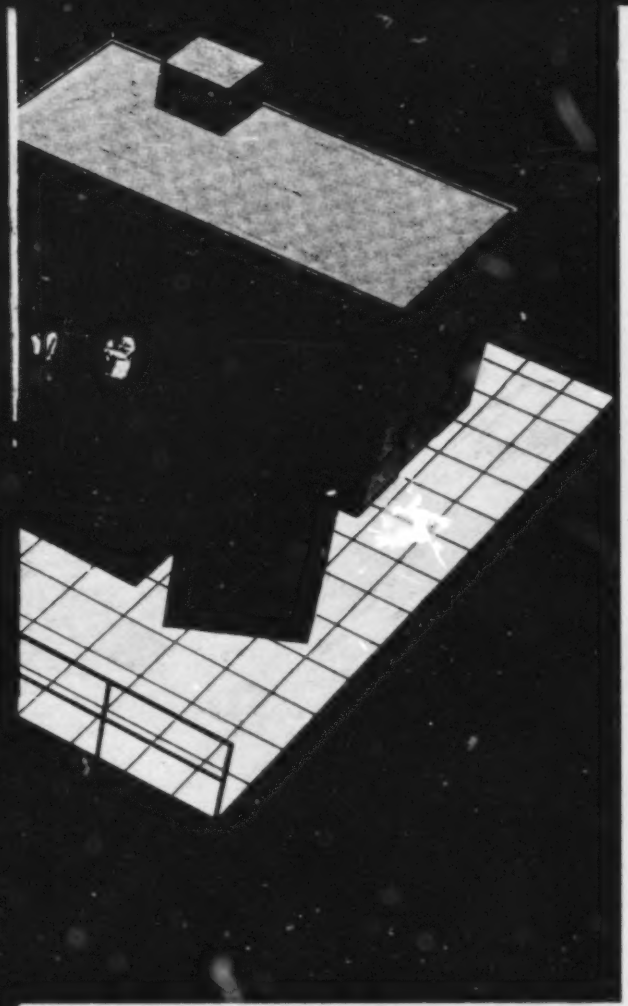
Community colleges were chosen as demonstration sites for TICCIT for a number of reasons. Community colleges are facing escalating demands on their personnel, physical, and financial resources. Also, they are educational institutions which historically have been receptive to instructional innovation. The two schools chosen were the Alexandria Campus of Northern Virginia Community College and Phoenix (Arizona) College of the Maricopa County Community College District.

The decision to develop courses in English composition and mathematics was based on several factors. These subjects constitute the areas of highest enrollment in community colleges; yet they are subjects in which a large proportion of students require remedial work. Moreover, they represent two very different instructional applications of CAI, which is an important factor in demonstrating the potential of computer-based instruction.

TICCIT systems were installed in the two community colleges in

MITRE's Peter Cole monitors the computer which services the TICCIT system at the Alexandria Campus of Northern Virginia Community College.

Employees' children took a beginning algebra course during the summer on the TICCIT system at MITRE's Washington Operations.



Training time for flight crews on the Navy's S-3A Viking anti-submarine aircraft is saved through use of training simulators. Reliance on the simulators, in turn, has been reduced by using TICCIT for earlier concept learning.

the spring of 1974, and the first students were enrolled in TICCIT math courses the following fall. Since that time, TICCIT courseware has been undergoing formative evaluation and pilot use in preparation for full-scale demonstration in the 1975-76 academic year. Several hundred students at each of the demonstration schools are now taking English and mathematics courses with TICCIT.

Brigham Young University has a smaller, 32-terminal TICCIT system, which has been used for courseware development. In the fall of 1975, BYU began offering TICCIT courses as part of its regular curriculum.

An eight-terminal TICCIT system at MITRE has been used for instruction since early 1975, when MITRE employees were offered a beginning algebra course through a special off-campus arrangement with Northern Virginia Community College (NVCC). During the summer of 1975, junior-high and high-school-age children of MITRE employees took TICCIT algebra, and MITRE will eventually make the full community college TICCIT program available to Washington Operations employees for credit under its special arrangement with NVCC.

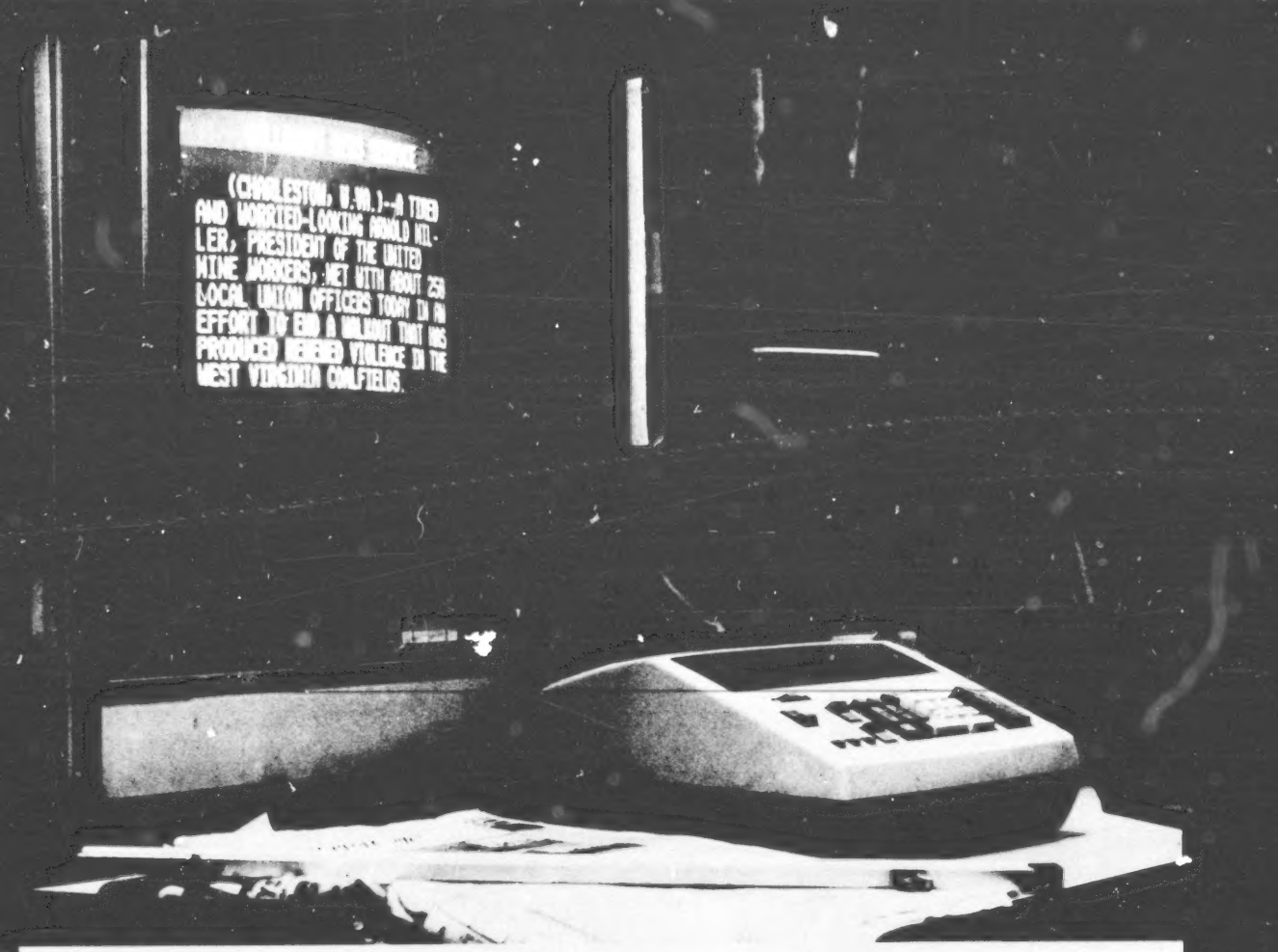
MILITARY TRAINING

Military training costs have been significantly reduced through the use of TICCIT because the system reduces training time and substantially lessens reliance on expensive hardware simulators. The system's ability to track student performance minutely and to provide instructors with up-to-the-minute student performance data contributes to TICCIT's efficiency as a training system.

TICCIT systems are presently being used for training at several military installations. The Navy is using TICCIT in two locations to provide initial and refresher training to flight crews for the S-3A Viking anti-submarine aircraft. The S-3A, which carries a highly sophisticated, computerized target-detection system, requires its four-man flight crew to make extensive use of computer displays. Training for such crews generally involves time spent in the classroom, then on a training simulator, and finally in the aircraft itself. Each simulator for an S-3A crew costs approximately $7 million and entails large computer-support operations. Reliance on these simulators has been substantially reduced by using TICCIT for earlier concept learning, so that fewer simulators are now required.

A mobile TICCIT system is installed at the Air University, Maxwell Air Force Base, Montgomery, Alabama, as part of an evaluation of computer-based instruction to support its worldwide educational extension program. MITRE's main processor in McLean, Virginia, interfaces with the mobile terminal system in Montgomery over a 2400-baud telephone line.

The Air University administers courses taken by 200,000 - 250,000 members of the Air Force each year.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AND WORRIED-LOOKING ARNOLD MIL-
LER, PRESIDENT OF THE UNITED
MINE WORKERS, MET WITH ABOUT 250
LOCAL UNION OFFICERS TODAY IN AN
EFFORT TO END A WALKOUT THAT HAS
PRODUCED RENEWED VIOLENCE IN THE
WEST VIRGINIA COALFIELDS.

Broadcast and standard cable television services, integrated with a comprehensive array of computer-based instructional resources, will provide a total communications, computation and CAI facility for the Model Secondary School for the Deaf at Gallaudet College in Washington, D.C.

Maintaining updated records has proven extremely difficult with such a large and widespread educational activity. Moreover, curriculum materials must be updated frequently, particularly for technical courses like aircraft engine maintenance. Through the Defense Advanced Research Projects Agency, the Air University is using TICCIT as one of two systems to evaluate the benefits of CAI in reducing their paperwork and administrative support requirements.

MITRE's mobile TICCIT system was installed at the Air University in May, 1975, and is being used for training in two occupational areas: cook assistant and warehouseman.

SPECIAL EDUCATION

The newest application of TICCIT technology is designed to meet the

(Above) Teacher communicates by sign language with students at the Model Secondary School for the Deaf (MSSD). (Below) Cable television system will provide visual instructional assistance such as in this open classroom at MSSD.

special needs of handicapped students. Two projects are currently underway to provide specially tailored, individualized instruction to such children.

Severely handicapped, homebound children in Amherst, New York, can now use interactive CAI in their homes via a TICCIT terminal system and cable television. MITRE, in conjunction with the New York State Education Department, developed and installed this unique system under funding from the Bureau of Education for the Handicapped, U.S. Office of Education. A Hewlett-Packard 2000F computer system is linked to a TICCIT terminal system to combine in one system both the large H-P instructional data base and the unique color and graphic capabilities of the TICCIT display. Standard, unmodified television sets in the children's homes serve as terminal display devices.

The computer system is installed in Amherst near the head end of the cable television system. The cable carries computer-generated video signals to the head end, where they are directed throughout the cable system to the children's homes.

The children have been provided with special keyboards and taught how to access the computer-stored, interactive materials. They have access on-demand to a wide range of educational lessons, games, and simulations.

TICCIT's newest and most innovative application is being developed for the Model Secondary School for the Deaf (MSSD), located in Washington, D.C., adjacent to Gallaudet College. In a single comprehensive system, MITRE is integrating broadcast as well as closed-circuit television, CAI, terminal-to-terminal communication, and general-purpose computing.

MSSD's new building, scheduled for completion in March of 1976, will house a complete cable television system using five parallel coaxial cables. It will have the capacity to serve 300 standard television sets, with any 64 of them capable of using TICCIT courseware simultaneously. Standard cable television services - videotape, off-the-air signals, programs originated in an in-house studio, and news wire - as well as CAI and administrative data processing will be available on any terminal.

A complete TICCIT system will be linked with an existing PDP-10 computer system at MSSD, so that the system can accommodate business and administrative tasks as well as instruction from the TICCIT terminals. Students will also be able to use telephone lines to access a national teletype system for the deaf, and 36 of the terminals will be equipped with videophones to enable the deaf students and teachers to communicate visually with one another, either individually or in groups.

The MITRE-designed system is expected to be the most advanced and comprehensive technical system in the nation for supporting the special educational needs of deaf students.